LAW AND PRACTICES FOR CHORNOBYL ECOSYSTEMS: INTEGRATING CONSERVATION WITH RADIO-NUCLIDES STABILISATION

Vasyl Nepyivoda (*)

SUMMARY: 1. Chornobyl before the explosion. — 2. Chornobyl ecosystems in the accident and its aftermath. — 3. Chornobyl-related legislation. — 4. Post-accident forestry management. — 5. Nature recovery. — 6. Establishing the *zakaznyk*.

1. *Chornobyl before the explosion*

Chornobyl (Chernobyl) lies in the central (Kyivan) part of Polissia, a territory between the Buh and Desna rivers. In Ukrainian the very word *Polissia* stands for "low lying forest terrain". This region with its impressive historical background is considered as the heartland of the Ukrainian nation, and, more generally, of Slavdom. For centuries local inhabitants, relatively isolated from the outside world by marshlands and forests, preserved their original culture in harmony with nature. Thus, the effects of the Chornobyl disaster extend far beyond environmental and economic harm to a wide range of social, medical, ethical, and cultural problems.

The natural history of this region, with its temperate continental climate, is typical of Europe. Peat bog with a substantial portion of marshland abounded before the total drainage campaign in the 1950-70s. In terms of vegetation zoning, it is part of the mixed-forest zone. Forests originally covered almost all the territory of the Chornobyl region. There was a devastating exploitative process during the 19th century. As a result of the clearing of land for agriculture and timber harvesting, the forest cover rate

(*) Ukrainian National Academy of Sciences.

dropped to only 11-12% in the early 1900s. However, the dramatic decrease in land fertility served as an impetus for reforestation. These activities reached their climax in the 1950-60s, leading to an increase in forest cover rate of up to 50%. Although forest acreage increased significantly, reforestation was generally focused on an effort to stock devastated areas with productive stands as quickly as possible. Therefore, monoculture plantations of Scotch pine (*Pinus sylvestris*) replaced former mixed old growth stands composed of pine and common oak (*Quercus robur*) with some of silver birch (*Betula pendula* and *B. pubescens*), aspen (*Populus tremula*), and alder (*Alnus glutinosa* and *A. incana*) ([1]).

2. *Chornobyl ecosystems in the accident and its aftermath*

On 26 April 1986, the world's worst nuclear accident occurred at the Chornobyl nuclear power plant, located 110 km north of Kyiv. The long-term impacts of the disaster are so serious that even in 2007, more than two decades after the disaster, a study of the New York-based Blacksmith Institute includes Chornobyl in the list of the ten most polluted places on the planet ([2]).

After the explosion the forests performed a unique role that could be compared with that of a vacuum cleaner. Dense forest vegetation almost completely prevented further aerial dispersal of radio-nuclides ([3]) (excluding those transported in the air from fires). Components of forest ecosystems absorbed the greater portion of the radioactive fallout, much more than farmlands which were more easily purified by rains. Most of the absorbed radionuclides are stored there. However, the price paid for this was high. In Ukraine alone (southern Belarus and the Bryansk region

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([1]) Ukrainian State Design Forest Inventory Enterprise, *Explanation to Materials of Forest Inventory at the State Specialized Production Complex Forestry Enterprise of Chornobyl Forest of the Administration of Exclusion Zone and Zone of Mandatory Resettlement* [in Ukrainian], Irpin, 1998, p. 123.

([2]) GARDNER, T., *Study Names World's Most Polluted Sites — Including Chernobyl, Reuters*, 12 September 2007, news.scotsman.com/?id = 1460872007.

([3]) As a result of the split of uranium nuclei in a nuclear reactor various unstable radioactive elements arise. These radio-nuclides or radioisotopes continue to decay releasing energy as radiation until a stable element is reached. The rate of radioactive decay is measured in curies (*www.chernobyl.info/en/*).

of Russia suffered from this disaster as well) 39% of all forests were exposed to the effects of serious radiation (with the level of soil contamination by caesium 137 amounting to more than 1 curie per square kilometre - Ki/km^2) (4). The so-called "Red Forest", a 1,500-ha pine stand, died out because of high direct doses of radiation. The disaster caused a 15 million cubic metre loss in standing timber (5). These forests are also lost for the purposes of the gathering of mushrooms, berries, nuts, and medicinal plants. Radiation seriously disrupted the gene pools of some species (6).

3. *Chornobyl-related legislation*

Following the accident, the large-scale relief activities at the nuclear plant, the burial of exposed equipment, the evacuation of the towns of Chornobyl and Prypyat and all rural settlements, the construction of new dams, roads, and waterways as well other deactivation and rehabilitation measures were carried out. After the last working reactor closed on 15 December 2000, efforts were refocused on minimizing the consequences of the accident and the maintenance of the affected area.

Such activities required a relevant legal background. Changes in the law in force at that time, as well as new legal acts, were already beginning to be introduced under the Soviets. In particular, the Chornobyl district of Kyiv oblast was dissolved. This process was continued after the proclamation of Ukraine's independence in 1991. The *Law on the Legal Regime of Territory Affected by Radioactive Contamination as a Result of the Chornobyl Disaster* (*Chornobyl Territories Act*, 1991), with numerous changes and amendments, constitutes a core of the so-called Chornobyl-related legislation in Ukraine. The *Forest Code of Ukraine* (1994/2006; Article 102) recognises the priority of this act in the issues of the

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(4) NADTOCHIY, P.P. et al., *The Experience of Combating the Chornobyl Catastrophe Consequences* (*Agriculture and Forestry*) [in Ukrainian], Kyiv, 2003, p. 81.

(5) LANDIN, V., *The Echo of Chornobyl* [in Ukrainian], in *Forest and Hunting Journal*, 1, 8, 2001.

(6) KINVER, M., *Chernobyl "not a wildlife heaven"*, *BBC News*, 14 August 2007, news.bbc.co.uk/1/hi/sci/tech/6946210.stm

preservation, conservation, utilisation, and reproduction of forests within the Chornobyl Zone.

Depending on the level of radioactive contamination, relevant territories are divided into four zones: exclusion zone, zone of absolute (mandatory) resettlement, zone of guaranteed voluntary resettlement, and zone of intensified radioactive control (*Chornobyl Territories Act*, Article 2). The exclusion zone (territories depopulated in 1986) and the zone of mandatory resettlement (areas intensively contaminated with long-decaying radioisotopes, *i.e.*, those with a level of soil contamination by caesium isotopes amounting to more than 15.0 Ki/km^2, or by strontium isotopes amounting to more than 3.0 Ki/km^2, or by plutonium isotopes amounting to more than 0.1 Ki/km^2) [*Chornobyl Zone*, "*Zone*"] are considered as state-owned land and are transferred for permanent use and management to the Administration of the Exclusion Zone and the Zone of Absolute (Mandatory) Resettlement [Zone Administration], a structure under the Ministry of Emergencies which has legal entity status. The decisions of the Administration are compulsory for all institutions and enterprises located within the Zone or involved in any activities there (*Chornobyl Territories Act*, Article 8). The Ministry of Emergencies coordinates all Zone-related activities, while the Cabinet of Ministers of Ukraine defines relevant economic and international activities (*Chornobyl Territories Act*, Article 5).

Administratively, the Zone, an area surrounding the former nuclear power plant roughly within a radius of 30 km (totally 204,045 ha), is situated on the territory of the modern Ivankiv and Poliske districts, at the northern part of Kyiv oblast, neighbouring the Chernihiv oblast of Ukraine and the Republic of Belarus. The area includes several tributaries of the Dnipro (Dnieper) River, notably the Prypyat and the Uzh.

The Zone's lands are marked off from contiguous territories. Rigorous limitations and prohibitions are imposed on this area. In particular, permanent residence, cattle grazing, wildlife habitat disturbance, non-commercial and commercial hunting and fishing are prohibited. The settlement of any person; the removal of timber, fodder, medicinal herbs, mushrooms, berries, and other non-timber forest products to outside the Zone; agriculture, forestry, and other production activities; construction; and transit through the Zone are allowed only following the granting of special per-

mission by the Ministry of Emergencies (*Chornobyl Territories Act*, Article 12). A strict protection regime for nature conservation areas and sites, as well as for historical and ethno-cultural monuments is to be guaranteed within the Zone (*Chornobyl Territories Act*, Article 14).

4. *Post-accident forestry management*

After the accident, conventional forestry management was stopped on this territory. However, it was impossible to ignore the clear evidence that in the coming decades the decay of timber in the natural cycle and forest fires would threaten radio-nuclide leakage into the environment. Timing is crucial in this case. Considering that most of the Chornobyl forests are of medium or young growth, proper forestry management should be able to prevent the effective release of radio-nuclides for three to seven decades. This time is sufficient for the self-inactivation and transformation into stable non-radioactive isotopes for most of the trapped radio-nuclides (7).

Never before had forest specialists been challenged to manage forests under a massive radioactive contamination. The specific conditions of these territories require special approaches for forestry management that differ drastically from traditional ones. The very idea of sustainable forestry is transformed under the pressure of radiation. In these circumstances its central aim is to prevent the migration of radio-nuclides to outside the borders of the Chornobyl Zone through the conservation and reproduction of forests. Besides the lack of scientific knowledge, the situation was aggravated by harsh budget constraints reflecting the country's economic transition. Since December 1992, the State Specialized Production Complex Forestry Enterprise of Chornobyl Forest has been responsible for forestry management within the Exclusion Zone. It is one of about 120 research, design, and production units involved in activities in the Zone under the authority of the Administration. Its area, amounting to 186,452

(7) NEPYIVODA, V., *Forestry in the Chornobyl Exclusion Zone: Wrestling with an Invisible Rival, Journal of Forestry*, 1, 103, 2005, pp. 36-40.

ha, includes forests and abandoned farmland. Regarding the Zone, forestry management encompasses a broad array of activities — from the preservation to the harvesting of forest products, but the prevention of further radio-nuclide dispersal through fire control is a principal goal. Every forest or grassland fire in the contaminated areas poses a threat. It could raise the radiation level through the secondary release of radioactive substances. Moreover, the fire-danger period is about 240 days per year in the Chornobyl area. Chornobyl Forest has managed to prevent large-scale wildfires since 1992 ([8]) and to maintain a stable trend of decrease in the number of wildfires (114 wildfires in 1999 compared with 34 in 2005) ([9]). Based on the knowledge that dense vegetation cover would prevent further dispersal of radio-nuclides and bind them, a strategy for replacing the affected forests and abandoned farmland with vigorous forests was chosen. Large-scale planting of forests has been under way since 1986. During the first decade after that 8,700 ha were planted ([10]). During the last years, planting activities within the Zone have been essentially decreased because of lack of funding and the good level of natural regeneration, and stabilized at an annual level of about 400 ha ([11]).

Timber and other forest products may now be harvested in the Chornobyl Zone and used outside the zone. However, such activities are subject to licensing and certification based on radiation checks that are established to prevent the proliferation of contaminated forest products. Chornobyl Forest managed to increase its annual volume of sanitation cutting and thinning from 4,000 in 1998 to 34,000 in 2002 ([12]). Therefore, it is perhaps the only unit within the Zone that could generate some revenue and at least partially cover expenditure.

([8]) BALASHOV, LEV., *Chornobyl Region - Land of Forests* [in Ukrainian], *World in Palms*, 2, 1996, pp. 22-25.

([9]) KULYNIAK, D., *The Chornobyl Forest Has Been Transformed into the Chornobyl Pushcha* [in Ukrainian], *Uriadovyi Kur'yer*, 1 February 2006.

([10]) Ukrainian State Design Forest Inventory Enterprise, *Explanation to Materials of Forest Inventory at the State Specialized Production Complex Forestry Enterprise*, cit.

([11]) VLASENKO, I., *Pushcha is not an abandoned area* [in Ukrainian], *Uriadovyi Kur'yer*, 18 July 2006.

([12]) VLASENKO, I., *Pushcha is not an abandoned area*, cit.

5. *Nature recovery*

Generally, changes in the Zone's ecosystem are compatible with the strategy of its recovery. Thus one observes a rapid (better than expected) natural forestation of non-forested lands. At least 15-20% of them can already be considered forests and in 20-30 years almost all of them will be covered with trees ([13]). The Red Forest is recovering gradually, with more radiation-resistant aspen and birch replacing pine ([14]). Dead pine monocultures, as well as aged pine stands devastated by fire, are succeeded by mixed pine-birch saplings. As a result, such ecosystems become enriched in terms of biodiversity, though the quality of new stands differs greatly, depending on the site. As a result of reforestation and natural regeneration the Zone's forest cover rate during the post-disaster period reached 55% and further growth is expected ([15]).

The impact of the Chornobyl accident on biodiversity is unambiguous. On the one hand, even low-level radiation is a negative factor for the diversity and abundance of organisms. This statement is supported, in particular, by the latest study, which recorded 1,570 birds from 57 species. According to the study, the number of birds in the most contaminated areas of the Zone declined by 66% compared with sites that had normal background radiation levels. It also reported a decline of more than 50% in the range of species as radiation levels increase ([16]). The Chornobyl fauna phenomenon, when numerous organisms with deleterious mutations appeared, but were weeded out very quickly, was labelled as "evolution on steroids" ([17]).

On the other hand, while it is still not a "wildlife paradise", the Chornobyl Zone now has a higher biodiversity and abundance than before the disaster. About 390 species of wild birds and

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([13]) SAVYCH, YU., M., POPKOV, M., *Forestry Lessons of Exclusion Zone of Chornobyl Nuclear Power Station* [in Ukrainian], in *Forest and Hunting Journal*, 3, 2001, pp. 9-11.

([14]) *Atlas of Chornobyl Exclusion Zone* [in Ukrainian, English and Russian], National Academy of Sciences of Ukraine, Kyiv Kartohrafiia, 1996, p. 22.

([15]) Ukrainian State Design Forest Inventory Enterprise, *Explanation to Materials of Forest Inventory at the State Specialized Production Complex Forestry Enterprise*, cit.

([16]) KINVER, M., *Chernobyl "not a wildlife heaven"*, cit.

([17]) MosNews, *Scientists see Chernobyl as Successful Wildlife Preserve*, 11 August 2005, *www.mosnews.com/news/2005/08/11/traveltochernobyl.shtml*.

mammals, the normal biodiversity pattern for the central part of Polissia, are represented here ([18]). Some 100 species on the *IUCN Red List of Threatened Species* are now found in the Zone. About 40 of these had not been seen there for decades ([19]).

Scientists unanimously agree that this thriving biodiversity is a direct result of the removal of human activities such as industrialisation, farming, cattle raising, hunting, logging, etc. ([20]). The conclusion that the world's worst nuclear accident has not been as detrimental to wildlife as are normal human activities is even more unexpected, when we consider the fact that Kyivan Polissia was the part of Ukraine with the lowest human population density even before the accident. At the same time, the risk to human health continues to be high in the Zone. Radiation shortens lives and raises perinatal mortality.

The Chornobyl Zone still has considerable potential to increase biodiversity and fauna abundance. The grey wolf (*Canis lupus*) is the only species whose population should be significantly reduced to its optimal level (50-60 animals). An optimal population for the elk (*Alces alces*) is about 600 individuals compared with the 120 present in 2000. For the European roe deer (*Capreolus capreolus*) this index is 3,000 to 200, for the European wild boar (*Sus scrofa*) — 700 to 250. The population of the European beaver (*Castor fiber*) might be increased tens of times, while the red deer (*Cervus elaphus*) population, amounting to about 80 animals in 2000, could grow almost unlimitedly. The Zone provides good habitats for the self-restoration of populations of the brown bear (*Ursus arctos*) and the Eurasian lynx (*Lynx lynx*), as well as such endangered species of birds as the great bustard (*Otis tarda*), the western capercaillie (*Tetrao urogallus*), the black stork (*Ciconia nigra*), the common crane (*Grus grus*), the golden eagle (*Aquila chrysaetos*), and the white-tailed eagle (*Haliaeetus albicilla*) ([21]).

([18]) POTAPCHUK, N., *A Reserve without Status: Are There Mutated Animals in the Exclusion Zone?* [in Ukrainian], *Den*, 74, 26 April 2005, *www.day.kiev.ua/136321*.

([19]) MosNews, *Scientists see Chernobyl as Successful Wildlife Preserve*, cit.

([20]) BAKER, R.J., CHESSER, R.K., *Letter to the Editor. The Chernobyl Nuclear Disaster and Subsequent Creation of a Wildlife Preserve, Environmental Toxicology and Chemistry*, 5, 19, 2000, pp. 1231-1232; see also: KINVER, M., *Chernobyl "not a wildlife heaven"*, cit.

([21]) Ministry of Emergencies of Ukraine, *The Programme for the Restoration of Indi-*

The reintroduction of species in order to fill the niche that was left vacant by their extinction in this region is another prospective direction. Primarily, they should fulfil the role of extinct megafauna in the Chornobyl grassland ecosystems. Potentially, the Zone could support a 500-animal population of wisent (*Bison bonasus*). It would also be possible to host a considerable population of Heck cattle (*Bos taurus*), often referred to as "the reconstructed aurochs". The aurochs (*Bos primigenius primigenius*), indigenous to this region, was eliminated during the 19th century ([22]).

The most successful case in this field relates to the Przewalski's horse (*Equus ferus przewalski*). This Asian wild horse is the closest living relative of the tarpan (*Equus ferus ferus*), a Eurasian wild horse. Like the aurochs, the tarpan was common to the Polissian ecosystem. However, the last individual horse died in the 1910s. In 1998-99, a Przewalski's horse population of 31 individuals was introduced to the Chornobyl Zone from Askaniya-Nova biosphere reserve in Kherson oblast. In six years this free-ranging population grew threefold. Moreover, in 2004 the second generation of Przewalski's horses was born in the Zone ([23]). This project is carried out within the 2000 *Programme for the Restoration of Indigenous Fauna Complexes and Biodiversity of Ukrainian Polissia within the Exclusion Zone and the Zone of Absolute (Mandatory) Resettlement* [*Fauna Programme*] involving a number of agencies: the Ministry of Emergencies (primarily Zone Administration and Chornobyl Forest), the Ministry of Environmental Protection, the Ukrainian National Academy of Sciences, and the Ukrainian Agrarian Academy of Sciences.

6. *Establishing the* zakaznyk

Undoubtedly, the year 2007 is a milestone for the legal regulation of the management of the Chornobyl Ecosystems. According

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genous Fauna Complexes and Biodiversity of Ukrainian Polissia within the Exclusion Zone and Zone of Absolute (Mandatory) Resettlement [in Ukrainian], Kyiv, 2000.

([22]) Ministry of Emergencies of Ukraine, *The Programme for the Restoration of Indigenous Fauna Complexes and Biodiversity of Ukrainian Polissia within the Exclusion Zone and Zone of Absolute (Mandatory) Resettlement*, cit.

([23]) YASYNETSKA, N., ZHARKYKH, T., *Horses from Nonexistence* [in Ukrainian], *Visnyk Chornobylia*, 9, 12 March 2005.

to the Presidential Decree of 13 August 2007 ([24]), a territory of 48,870 ha within the Zone (about 24% of its total acreage) was proclaimed a general zoological *zakaznyk* of national importance, the "Chornobyl Special" ([25]). This Decree was adopted in order to preserve the unique properties of the Zone's forest stands. As a part of Kyivan Polissia they serve as Ukraine's most significant refuge for wildlife which requires protection and population regulation. The President instructed the Cabinet of Ministers to approve the statute of the *zakaznyk* and to transfer this territory to the Zone Administration for protection.

The idea of expanding reserved territories to include a large part of the Chornobyl Zone area is not new ([26]). Moreover, ten plots within the modern Zone have had the status of protected areas (PAs) since pre-accident times. The rationale behind the latest decree is also clear. It formalises the status of the Zone which serves as a deserted *de facto* natural preserve. Now all Chornobyl ecosystems are under intensive natural transformation, with only minimal human interference. Hence, they represent a unique pattern for comparison with radiation-free areas which are subject to conventional human activities. Moreover, the Zone has also become a wildlife sanctuary, where undisturbed fauna is flourishing despite the radiation impact. The establishment of the *zakaznyk* was made in the context of the creation of the national ecological network. It will also provide a good basis for the intensification of co-operation in this field with Belarus, where the *Polieskiy Radio-ecological Reserve* located in neighbouring Homiel oblast has similar goals.

Though the relevant bylaw has not yet been adopted, it is already possible to identify the features of Chornobyl Special, as well as the challenges that face it. According to the 1992 *Law on the Nature Reserve Fund of Ukraine*, *zakaznyks*, a part of this fund, are natural territories established for the preservation and reproduction

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([24]) 2007 Decree of the President of Ukraine *on the Proclamation of Natural Territory as a General Zoological Reserve of National Importance "Chornobyl Special"* [in Ukrainian].

([25]) Cf. IVANENKO, I., PARCHUK. G., *Protected Areas of the Kyiv Region*, supra, pp. 227 ff.

([26]) BAKER, R.J., CHESSER, R.K., *Letter to the Editor. The Chernobyl Nuclear Disaster and the Subsequent Creation of a Wildlife Preserve*, cit.

of ecosystems ([27]) or their components (*Reserve Fund Act*, Article 25). The Law lays down the principal requirements for the *zakaznyk* regime. Activities that are in contrast with goals defined in the statute of the *zakaznyk* will be limited or prohibited. Those economic, scientific and other activities that are not in contradiction with these goals must comply with the general requirements of environmental protection (*Reserve Fund Act*, Article 26). This differentiates *zakaznyks* from other PAs, such as natural reserves, where all economic activities are prohibited (*Reserve Fund Act*, Article 15).

Generally, forests could thrive without any human interference. However, this result is not so obvious in the case of forest ecosystems exposed to a thousand years of anthropogenic pressure as are those in the Chornobyl region. Even before the explosion, artificial Scotch pine plantations amounting to about half of all the Zone's forests, despite good growth, manifested serious problems such as damage from wildfire, windstorms, fungi, and insect pests ([28]). These negative impacts continue to exist. For instance, insect pests caused damage estimated at at least US$ 150,000 to forest stands in 2006 ([29]). The accident added a strong limiting factor-radiation. Generally, nature corrects human mistakes. There is no doubt that without human intervention some stable plant communities would still develop in the Chornobyl Zone. However, in many cases low-density coppice is being formed.

It is also clear that this scenario would mean an inevitable degradation of existing forests. In this case the transportation of radio-nuclides to new territories through fires and timber decay would probably be equal to a new series of explosions. Hence, "a continuous investment in reducing the hazard [of wildfires through forestry management] would be much better than the alternative" ([30]). For this purpose it is necessary to remove by sanitation cutting and thinning about 1 million cubic metres of tim-

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([27]) The term "natural complexes" is used in this particular clause. It is also predominant in Ukrainian legislation.

([28]) Ukrainian State Design Forest Inventory Enterprise, *Explanation to Materials of Forest Inventory at the State Specialized Production Complex Forestry Enterprise of Chornobyl Forest of the Administration of Exclusion Zone and Zone of Mandatory Resettlement*, cit.

([29]) CHECHEL, L., *Horses from nonexistence* [in Ukrainian], *Visnyk Chornobylia*, 31, 5 August 2006.

([30]) CONIFF, R., *Fire and the Nuclear Forest*, in *Environment Yale*, Spring 2007, p. 22.

ber within the Zone ([31]). Therefore, in the case of Chornobyl, passive preservation is not an optimal way either for restoring viable indigenous ecosystems or for preventing further radio-nuclide dispersal.

The decision to choose the *zakaznyk* as a type of PA for the Zone is probably the best one. Such status provides a sufficient legal tool for combining conservation activities with forestry management entrusted with the stabilisation of radio-nuclides and the restoration of indigenous ecosystems. Such ideas should be implemented in the statute of "Chornobyl Special". Generally, this document defines the goals and scientific specialisation of the zakaznyk, and the specific features of its protective regime and activities. It must be approved by the Ministry of Environmental Protection (*Reserve Fund Act*, Article 5).

The status of "Chornobyl Special" as a *zakaznyk* of national importance is due to its significant ecological, scientific, historic, and cultural value (*Reserve Fund Act*, Article 3). It is also clear that the well-being of wildlife is to be a priority in the future activities of the *zakaznyk*. This follows from its status as a general zoological *zakaznyk*, rather than a landscape, forest, or botanical one. These and several other categories are identified for *zakaznyks* depending on their origin and natural characteristics, goals, and protection regime (*Reserve Fund Act*, Article 3).

Though the law allows for different forms of ownership of *zakaznyks* (*Reserve Fund Act*, Article 4), in the case of "Chornobyl Special" this issue is simplified because all the Zone's land is state-owned. Expenditure relating to the protective regime of *zakaznyks* is to be met by the institutions managing those territories. However, if special measures are needed to avoid the destruction of, or damage to, ecosystems within a *zakaznyk* of national importance, relevant funding may be allocated from the state budget (*Reserve Fund Act*, Article 46). *Zakaznyks* are eligible for land tax exemption (*Reserve Fund Act*, Article 49).

The setting-up of "Chornobyl Special" may contribute, at least in theory, to combating poaching, because of the more severe penalties for this offence when committed within PAs. At the mo-

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([31]) KULYNIAK, D., *Help to Chornobyl Pushcha* [in Ukrainian], *Uriadovyi Kur'yer*, 14 November 2006.

ment, poaching is the most devastating factor against Chornobyl wildlife. For instance, the annual loss in the population of Przewalski's horses due to poaching is evaluated at twenty animals ([32]).

In 2007, several changes having indirect, but essential, effects on the Chornobyl Zone ecosystems were introduced into Ukrainian law. The most significant ones relate to violations of radiation safety requirements. Previously, the removal by any method of items to outside the border of the Zone without relevant permission, or without radiation checks, was considered an administrative offence only. Now, depending on the circumstances, it is also qualified as a criminal offence and may be penalised not only by fines, but also by imprisonment of up to seven years (2001 *Penal Code of Ukraine*, Article 267-1). "Item" is interpreted in its broadest context. This term includes food products of plant or animal origin, industrial or other products, animals, fish, plants, or any other object.

The fact that the illegal removal of various materials to outside the Zone had already became a large-scale shadow business, served as a motivation for the above-mentioned changes in the law. The value of such removals during 2006 alone is evaluated in about US$ 20 million ([33]).

In December 2006, Chornobyl Forest was reorganised as the State Specialized Complex Enterprise of Chornobyl Pushcha (wilderness; thick, pathless forest) under the Ministry of Emergencies, and additional areas within the Zone were transferred under its management ([34]). While the conservation component (specialised radiation, fire and sanitation checks, and forestation of abandoned farmland) is emphasised, the resumption of the forest products industry is no longer considered among the enterprise priorities.

Though in general such reorientation is in line with the strategy to establish a PA within the Zone, a number of serious chal-

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([32]) Since 1998 a considerable population of Przewalski's horses has existed in the Chornobyl Zone, see: DEREV'YANKO, A., FOMIN, A., *5 Kanal*, 26 April 2006.

([33]) *From now on, Illegal Entry into the Chornobyl Zone is a Subject for Criminal Responsibility* [in Ukrainian], Korrespondent.net, 14 June 2006, ua.korrespondent.net/main/76885.

([34]) KULYNIAK, D., *Chornobyl Forest Has Been Transformed into Chornobyl Pushcha*, cit.

lenges must be addressed. Lack of funding is among the principal ones. Since the reformation, the removal of timber to outside the Zone has been prohibited. Previously, Chornobyl Forest sold about 12,000 cubic metres of timber for mining props, and received about US$ 300,000 of annual revenue. Taking into consideration that state budget funding for the enterprise dropped from about US$ 180,000 in 2001 to US$ 72,000 in 2005, revenue from timber sales is of vital importance. Moreover, it is not clear how to dispose of timber from thinning and sanitation cutting (those activities must be continued for the prevention of radio-nuclide dispersal).

Budget constraints are also a primary reason for the decrease in the number of staff from 732 persons in 2000 to 521 persons in 2005. As part of the reorganisation, a further cut in staff of 200 persons is expected. At the same time, the new goals of Chornobyl Pushcha, as well as additional areas under its management, require a staff of at least 1,000 people ([35]). As a result of this situation, the average acreage of a guard sector (primary territorial unit formed to protect forests against illegal logging, plundering, fires, poaching, and other forest violations) within the Zone is about 1,700 ha compared with the average guard sector in Ukraine of about 500 ha. Moreover, Chornobyl rangers who run guard sectors must carry out some other physical work because of the impossibility of hiring part-time workers from the among local people ([36]). In addition, foresters are exposed to a serious health hazard. The dose of their exposure to highly penetrating gamma radiation is 1.5 higher than that of an average inhabitant of the Zone ([37]). The Administration's scientific department experience the same personnel problems. Hence, it is able to carry out only very basic observation and research.

Competition and clashes between different agencies, as well as within the same agency, is potentially a serious obstacle for the success of Chornobyl conservation activities. The prolonged confrontation between Chornobyl Forest and the Fauna Programme

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([35]) Cf. KULYNIAK, D., *Chornobyl Forest Has Been Transformed into Chornobyl Pushcha*, cit.

([36]) KULYNIAK, D., *Help to Chornobyl Pushcha*, cit.

([37]) NADTOCHIY, P.P. et al., *The Experience of Combating the Chornobyl Catastrophe Consequences (Agriculture and Forestry)*, cit.

for the management of the fauna guard service is the most striking example of such a conflict. However, the very status of Chornobyl Special implies the interaction of different agencies. On the one hand, territorially and administratively it is part of the Exclusion Zone and the Zone of Absolute (Mandatory) Resettlement under the Ministry of Emergencies. On the other hand, the Ukrainian National Academy of Sciences jointly with the Ministry of Environmental Protection must co-ordinate scientific research on the territories of the Natural Reserve Fund (*Reserve Fund Act*, Article 42). Thus, the most favourable option is to find optimal approaches for stable co-operation between the agencies.

Therefore, the unprecedented impact created by the Chornobyl disaster could be addressed in the area of environment through the effective combination of measures for the prevention of further radio-nuclide dispersal and for the recovery of affected ecosystems. The establishment of the "Chornobyl Special" *zakaznyk* is a weighty step in this direction. However, the success of its activities will depend on overcoming the existing difficulties, especially the shortage of funding.